CALIFORNIA DIVISION OF MINES AND GEOLOGY

Fault Evaluation Report FER-22

January 19, 1977

1. Name of fault: Santa Ynez fault (eastern segment).

2. Location of fault: Devil's Heart Peak, Topatopa Mountains, Lion Canyon, Wheeler Springs, Old Man Mountain, and White Ledge Peak quadrangles, Ventura County (Note: the fault extends westward into Santa Barbara County; that segment is evaluated in another FER).

3. Reason for evaluation: Part of a 10-year program; the Santa Ynez fault is zoned as a secondary fault hazard in the Ventura County Seismic and Safety Element (Nichols, 1974).

4. List of references:

a) Badger, R.L., 1957, Geology of the western Lion Canyon quadrangle, Ventura County, California: California University, Los Angeles, M.A. thesis, map scale 1:14,000.

Note: Map was missing from UCLA copy that was reviewed.

b) Bortugno, E.J., work in progress, 1976 (to be included in another FER: California Division of Mines and Geology).

c) Buchanan, J.M., Ziony, J.I., and Castle, R.O., 1973, Recent elevation changes across part of the Transverse Ranges near Ventura, California: Geological Society of America, Abstract with Programs, v. 5, no. 1, p. 17. (1)

* d) Dibblee, T.W., Jr., 1946, unpublished geologic map of the Wheeler Springs quadrangle, scale 1:31,680.

* also Buchanan-Banks, J.M., Castle, R.O., and Ziony, J.I., 1975, Elevation changes in the Central Transverse Ranges near Ventura, California: Tectonophysics, v. 29, p. 113-125.

e) Dibblee, T.W., 1947, Unpublished geologic map of Ventura quadrangle: U.S. Geological Survey, scale 1:62,500.

f) Dibblee, T.W., 1949a, Unpublished geologic map of Devil's Heart Peak quadrangle: U.S. Geological Survey, scale 1:31,680.

g) Dibblee, T.W., Jr., 1949b, Unpublished geologic map of the "Hines Peak" quadrangle, scale 1:62,500.

Note: No topo on base map, no roads -- streams only.

h) Dibblee, T.W., 1949c, Unpublished geologic map of Lion Canyon and Topatopa Mountains quadrangles: U.S. Geological Survey, scale 1:62,500.

i) Dibblee, T.W., Jr., 1966, Geology of the central Santa Ynez Mountains, Santa Barbara County, California: California Division of Mines and Geology Bulletin 186, 99 p.

j) Dickinson, W.R., 1969, Geologic problems in the mountains between Ventura and Cuyama In SEPM, Pacific Coast Section 1969 field trip, upper Sespe Creek: SEPM Pacific Coast Section, p. 1-23.

k) Hagen, D.W., 1957, Geology of the Wheeler Springs area: California University, Los Angeles, unpublished M.A. thesis, map scale 1:21,180.

l) Jennings, C.W., 1975, Fault map of California with locations of volcanoes, thermal springs, and thermal wells: California Division of Mines and Geology, California Geologic Data Map Series, Map no. 1, scale 1:750,000.

m) Jennings, C.W., and Strand, R.G., 1969, Geologic map of California, Los Angeles sheet: California Division of Mines and Geology, scale 1:250,000.

n) Jestes, E.C., 1963, A stratigraphic study of some Eocene sandstones, northeastern Ventura basin, California: California University, Los Angeles, Ph.D. thesis, map scale 1:42,500.

o) Nichols, D.R., October 1974, Surface faulting in ~~General Discussion in~~ Seismic and Safety Elements of the Resources Plan and Program, Ventura County Planning Department, section II, p. 1-35, plate 1.

p) Shmitka, R.O., 1968, Geology of the eastern portion of Lion Canyon quadrangle, Ventura County, California: University of California, Davis, unpublished M.S. thesis, 86 p., 7 plates, map scale 1:12,000.

q) Stanford Geological Survey, 1963, Geologic map of the upper Sespe Creek area, Ventura County, California: unpublished, map scale 1:24,000.

r) Weber, F.H., Jr., Kiessling, E.W., Sprotte, E.C., Johnson, J.A., Sherburne, R.W., and Cleveland, G.B., 1975, Seismic hazards study of Ventura County, California, California: California Division of Mines and Geology, Open File Report 76-5 LA, 396 p., 9 plates, map scale 1:48,000.

s) Willot, J.A., 1972, Analysis of modern vertical deformation in the western Transverse Ranges, unpublished M.A. thesis, University of California, Santa Barbara, 81 p.

t) Ziony, J.I., Wentworth, C.M., Buchanan-Banks, J.M., and Wagner, H.C., 1974, Preliminary map showing recency of faulting in coastal southern California: U.S. Geological Survey, Miscellaneous Field Studies Map, MF-585, 15 p., map scale 1:250,000, 3 pl.

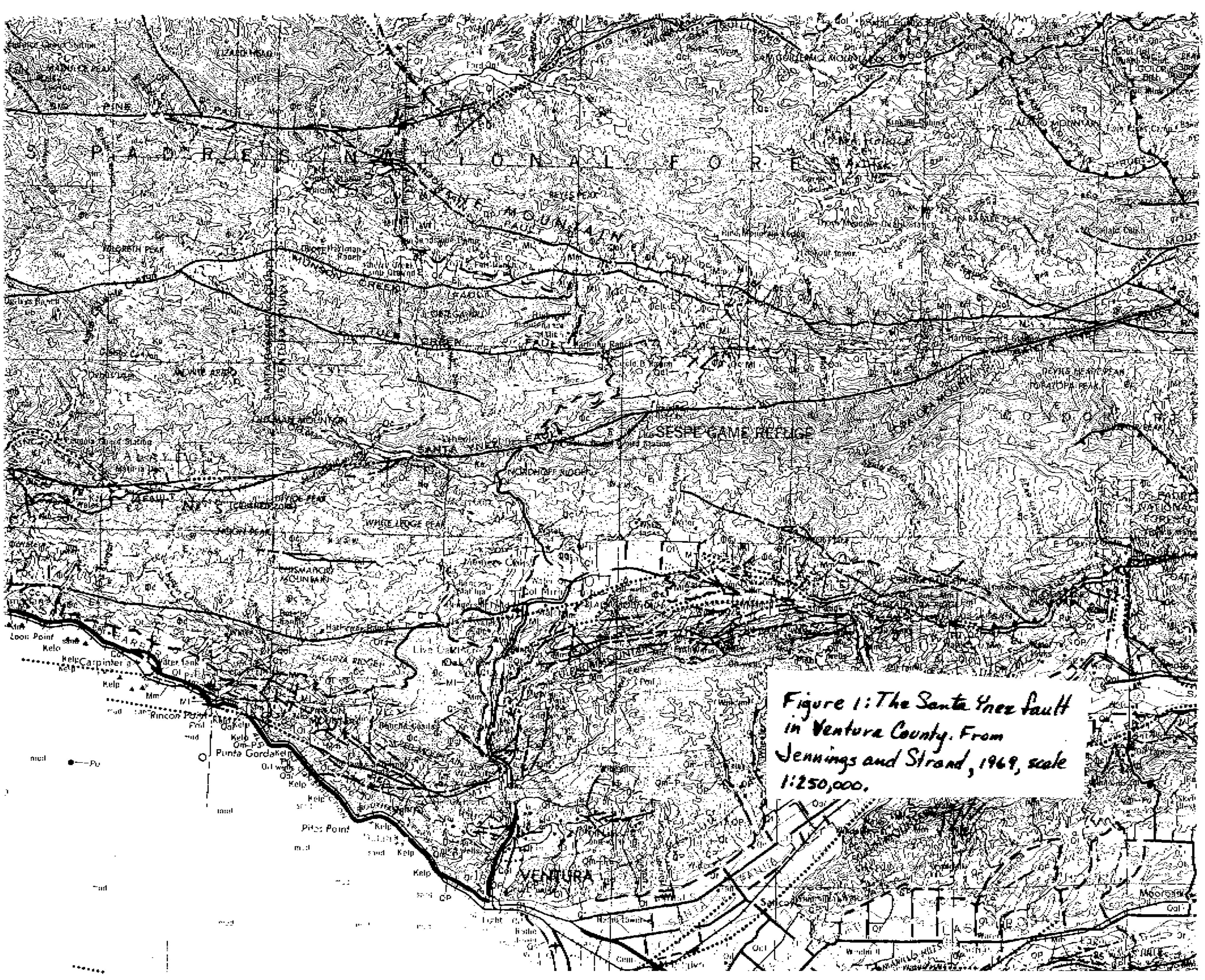

Figure 1: The Santa Ynez fault in Ventura County. From Jennings and Strand, 1969, scale 1:250,000.

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5. Summary of available data:

The Santa Ynez fault was zoned in the Ventura County Seismic and Safety Elements as a secondary fault hazard (Nichols, 1974, after Jennings and Strand, 1969). Nichols notes (p. 19) that "past displacement has been about 10,000 feet of relative uplifting on the south side" of the 90 mile long fault, and "Left lateral displacement of streams crossing the fault has been cited as evidence for recent fault movement." Citing several earthquake epicenters that have been located along the fault in Ventura and Santa Barbara Counties, Nichols considers the Santa Ynez fault "potentially active until additional information is available for evaluation."

Dickinson (1969, p. 10) felt that both strike-slip movement and dip-slip movement has taken place along the Santa Ynez fault. Jestes (1963) felt that the Santa Ynez fault is primarily a left-lateral fault. Jestes map shows no Quaternary units along the Santa Ynez fault.

Much of the fault has been mapped by T.W. Dibblee, Jr. (1946, 1947, 1949a, 1949b, 1949c). Summarizing the information contained in these maps, Dibblee depicts the fault as buried beneath terrace or fanglomerate deposits (Pleistocene) and alluvium. The youngest faulted unit is Sespe Formation (Oligocene).

Theses were completed in areas along the Santa Ynez fault by Badger (1957), Hagen (1957), and Shmitka (1968). The geologic map was missing from Badger's tehsis, however, he noted that the fault was "not conspicuous" where the rock units on either side are "of similar resistance." In the western half of his field area, where the resistance of the units differ (Coldwater sandstone against Cozy Dell shale), a fault-line scarp exists. Hagen (1957) mapped the fault as not cutting older alluvium (Pleistocene) and as cutting no unit younger than Cozy Dell Formation (Eocene). He noted that there usually was a wide zone of shearing, gouge, and breccia along the fault. He felt that this shear zone was weaker than the surrounding competent bedrock, and thus was more easily eroded, yielding features such as saddles and linear valleys. He noted that there was no "distinctive" topographic expression along the sides of hills ("distinctive" is presumed to mean features distinctive to active or recently active faults). Hagen (p. 83) specifically mentions "The absence of offset drainage patterns ..." Hagen determined that the Santa Ynez was nearly vertical, with both vertical (south block up) and strike-slip components of ~~is~~ slip.

Shmitka (1968) found that, in the western half of his field area, the Santa Ynez fault formed a prominent fault-line scarp. In the eastern half of his area, he felt that the fault was not expressed in the topography. Shmitka noted that the zone of faulting was about 15 feet wide. At Rose Valley falls, he measured the dip as 75° to the south. Shmitka felt that the fault was primarily a high-angle reverse fault. He found no evidence (such as east-west slickensides or lateral stratigraphic offset) that would indicate that lateral movement had occurred along the fault.

The Stanford Geological Survey (1963) map depicts the Santa Ynez fault as cutting alluvium (Holocene) at two locations in the Lion Canyon quadrangle and as buried under alluvium in a third location. I suspect that the faulting of alluvium is a drafting error; however, no other young units occur along the fault in the field area. The youngest faulted unit is Sespe Formation (Oligocene in age).

Weber, et al. (1975) notes that the Santa Ynez fault dips steeply north in some places and steeply south in others. They note a crude alignment of epicenters along the fault. They note (after Dibblee, 1966) that 2900 feet of vertical displacement has been calculated, and that both right-lateral (30 miles) and left-lateral (9 to 37 miles) displacement has been suggested. Left-slip displacement of stream courses (few hundred meters to 5 km.) has been suggested in the Santa Barbara County area (see Bortugno, 1976 and Dibblee, 1966). Also, they state (p. 179) "In Ventura County, older alluvium may be displaced in vicinity of Matilija Creek."

Geodetic data have been presented by Willot (1972) and Buchanan, et al. (1973), and Buchanan-Banks, et al. (1975). Willot noted that the Santa Ynez fault "appears to be active" since 0.8 cm of vertical rise took place near Gaviota, over a 14 year period, near the south branch of the fault. Bortugno (personal communication, 1976) notes that this "offset" may not be valid; it appears that the benchmarks between which the "offset" is noted are both on the same side of the fault.* ① ②

Buchanan, et al., and Buchanan-Banks, et al. however, states that "Differential elevation changes could not be detected across ... the Santa Ynez fault near Wheeler Springs." They do, however, note that the Santa Ynez "exhibit~~(s)~~[er(?)] evidence of late Pleistocene movements" but that Holocene displacements are unknown. ①

6. Interpretation of air photos:

U.S. Department of Agriculture aerial photographs flown in 1953, scale 1:24,000 were viewed stereoscopically. In addition to the photographs noted on plates 1, 2, and 3, flight AXI 5D6 8K, numbers 110 to 116 (Devil's Heart Peak quadrangle) were also viewed. No features commonly associated with recently active faults were noted on these photos.

*see FER on south branch of Santa Ynez; Bortugno was reconsidering the data as of 1/20/77.

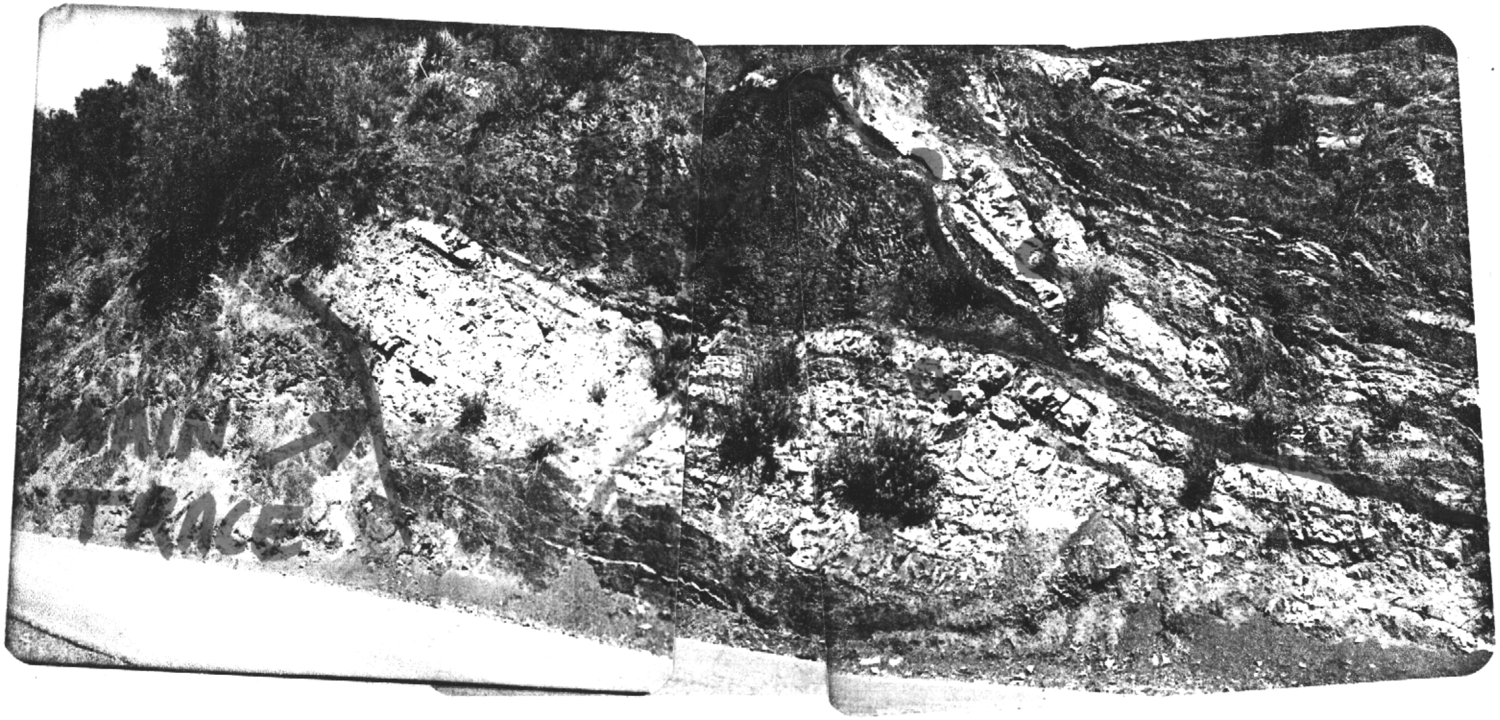

Photo 2 Photo 3 Photo 4

Figure 2. Composite photograph (of photos 2, 3, and 4). Main fault shears are noted. (Photos are in pocket; these 3 photos plus photo 1 overlap, permitting stereo viewing. Horizons labeled "a" may be the same horizon.)

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Photo 5

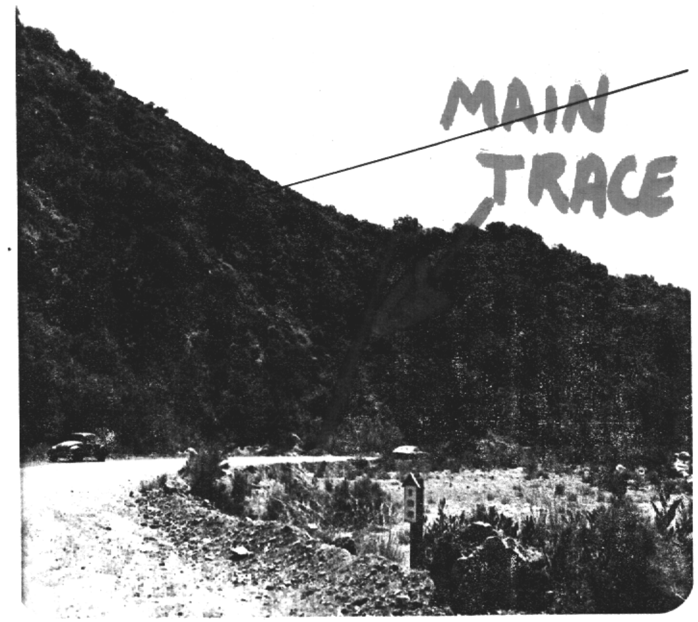

Photo 6

Figure 3. View of figure 2 [1] looking west. Note topography (up on south) ; opposite of postulated sense of movement.

Figure 4. View of topography looking east, backside of figures 2 and 3.

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One feature worth special mention was noted in the Topatopa Mountains quadrangle (plate 1). This feature could be traced for about 1 1/2 miles. This tonal lineament, which coincided with a slight escarpment, could not be traced through alluvial deposits in section 2 (T. 5 N., R. 21 W.). One of the two locations where the Stanford Geological Survey (1963) mapped the fault as cutting alluvium was checked on air photos (see plate 2). No evidence that the alluvium was cut was noted in this location.

Along the entire length of the Santa Ynez fault, selected streams appear to be offset. However, other streams cross the fault, as mapped, without any such offset.

7. Field observations: Time did not permit a detailed field evaluation to be made of the Santa Ynez fault. On June 25, 1976, I attempted to visit the two sites where the fault is mapped by the Stanford Geological Survey as cutting Quaternary alluvium. Unfortunately, the main road into the area was closed to traffic (it was being paved). The lineament mentioned above (in item 6) was in a remote area which, at that time, was closed due to extreme fire danger.

I tried to observe the fault at the Wheeler Gorge Guard Station. Unfortunately, the fault is not exposed in a road cut at this location. Further west, near Wheeler Springs, the fault is obscured by colluvium.

I was able to observe the fault in section 24, T. 5 N., R. 24 W. (see plate 3). Photographs of the fault zone are included in this report. The fault dips steeply northward at this locality. It also forms a slight break in slope. This topographic break is probably erosional in origin because the southern block appears to have been elevated, which is just the opposite of the postulated sense of movement. No topographic feature was noted in the creek deposits. Unfortunately, the area west of this location was also closed for the fire season.

8. Conclusions: The majority of the original data available for the Santa Ynez fault in Ventura County indicates that the Santa Ynez fault has probably not been active during the late Quaternary. Dibblee (1946, 1947, 1949a, 1949b, 1949c) and Hagen (1957) depict the fault as not offsetting Pleistocene terrace deposits. The Stanford Geological Survey (1963) depicts the fault as cutting a Quaternary unit (alluvium) in two places in the Lion Canyon quadrangle, but this is most probably the result of two drafting errors.

Weber, et al (1975) suggest~~s~~ that the older alluvium near Matilija Creek may be faulted, but ~~his~~ their data could not be field checked due to the extremely dangerous fire conditions.

The Santa Ynez fault may possibly have been active during late Quaternary; however, there is no ~~indication~~ conclusive evidence of Holocene activity along the fault. This data concurs with that data that Bortugno (work in progress) has at this time. Since the fault forms a major geologic break, in some areas one would expect it to be relatively well defined in those areas. However, as demonstrated in Photos 2, 3, and 4, where bedrock on both sides is similar*

9. Recommendations: Based on the information summarized herein, the Santa Ynez fault should not be zoned at this time. There is some suggestion that the fault has been active during late Quaternary time, but more detailed field investigations in rather remote areas are necessary in order to prove or disprove this hypothesis.

I concur with recommendation. However, new information may cause us to re-evaluate this major, complex fault.

EWH
1/26/77

*(continued) and parallel to the bedding, the fault may be a zone within which the most recently active trace may be difficult, if not impossible, to determine.

10. Investigating geologist's name; date:

Theodore C. Smith

Theodore C. Smith
Assistant Geologist
January 19, 1977

Reviewed by EWH; see comment preceding page.